

SUBSTITUTE SPECIFICATION SHOWING CHANGES

## Specification

## TOOL HOLDER OF MACHINE TOOL

## TECHNICAL FIELD

- 5           The present invention relates to a tool holder that ~~which~~ has mist cutting fluid fed from a spindle of a machine tool spout from the tip of a shaft-like tool.

## PRIOR ART

- 10           In machining with a machine tool, much cutting fluid is fed to a workpiece ~~work-piece~~ or a machining point to cool or lubricate a tool or to remove cutting chips. In this case, there are many problems, such as environmental pollution, ill effects to ~~environmental pollution or~~ human health, high cost caused by waste oil disposal of the cutting fluid, deterioration of the life span of the tool due to supercooling the workpiece ~~work-piece~~, and sliding wear of the tool due to excessive cutting fluid in minute cutting. Besides, since much cutting fluid adheres to ~~on~~ the cutting chips in machining, the
- 15           adhered cutting fluid must be separated in the ~~ease of~~ disposal or recycling of the cutting chips.

          In recent years, to settle the above problems, there have appeared machine tools performing so-called dry cutting that cut while as feeding a very small quantity of mist cutting fluid to machining points.

- 20           A tool holder used in the machine tool is, for example, constructed as follows. As shown in Fig. 11, a holder rear end part is fixed on a front end of a spindle of the machine tool, and a tool receiving part 8d and mist cutting fluid passages 9c, 8f are formed at ~~on~~ a rotating center of rotation ~~rotation~~ R in a holder body 7. The tool receiving part 8d receives the outside periphery of a rear end surface of a shaft-like tool 11 fixed on a holder front end part so as to form a closed space 12 in contact with the rear

end face. The mist cutting fluid passages 9c, 8f lead the mist cutting fluid fed from the front end part of the spindle to the closed space 12.

During machining ~~with due to~~ the shaft-like tool 11, the mist cutting fluid fed from the spindle reaches the closed space 12 through the passages 9c, 8f, thereafter flowing from the front face of the shaft-like tool 11 through passage holes 11a, 11a formed ~~in to~~ the thickness portion thereof.

In the above-mentioned dry cutting, for example, although the shaft-like tool 11 having a small ~~in~~ diameter of about 1 mm to 5 mm is used, the diameter of the passage holes 11a is about 0.1 mm to 0.5 mm, which is remarkably smaller than that of the passages 9c, 8f.

The small diameter of the passage holes 11a diminishes the amount of outflow of the cutting fluid therethrough per hour, thereby deteriorating the flow velocity of the mist cutting fluid in the passages 9c, 8f.

~~In~~ Under this situation, when the tool holder rotates over about 6000 times per minute, mist cutting fluid ~~to be for being~~ fed into the passages 9c, 8f or the closed space 12, which is likely to stagnate, is affected by centrifugal force due to the rotation, ~~thereby promoting to be promoted~~ liquefying. Since liquefied cutting fluid can not flow as easily as ~~rather than the~~ mist cutting fluid, it is gradually accumulated in circularity on wall faces of the passages 9c, 8f and comes to restrict the flow of the mist cutting fluid with progress of time. And finally, it becomes difficult to feed a sufficient quantity of mist cutting fluid to the tip of the shaft-like tool 11.

The present invention aims to solve ~~settle~~ the above-mentioned problems and to provide a tool holder of a machine tool having a required quantity of mist cutting fluid continuously flowing from the tip of a shaft-like tool.

## SUMMARY OF THE INVENTION

To achieve the above-mentioned aim, ~~a the first~~ feature invention of the present invention is constructed as follows~~ing~~. That is, a tool holder is so constructed that a tool receiving surface part for receiving a rear end face of a shaft-like tool fixed on a holder front end part so that a closed space in contact with the rear end face can be formed, as well as mist cutting fluid passages for leading mist cutting fluid fed from a front end part of a spindle to the closed space are formed ~~at on a rotating~~ on a rotating center of rotation of a holder body, and that exhaust passages are formed for opening the closed space 12 (especially, a part of the tool receiving surface part) to the atmosphere except for the passage holes 11a of the shaft-like tool 11 in contact therewith.

According to this, even if only a little mist cutting fluid passes through the passage holes of the tool because the shaft-like tool is small in diameter, the mist cutting fluid in the closed space flows from the exhaust passages to the atmosphere with a suitable ~~by suitably~~ flux and the mist cutting fluid passages are decompressed. Therefore, the mist cutting fluid in the mist cutting fluid passages has the flow velocity maintained at proper levels, so as to be restricted from liquefying. Besides, even if the mist cutting fluid is liquefied, it is immediately carried into the closed space by the mist cutting fluid with a in large flow velocity, thereafter flowing to the atmosphere through the passage holes of the shaft-like tool and the exhaust passages.

In this case, it is preferable that the exhaust passages have a circular portion of outer concentric portion of mist cutting fluid passages near the rotating center of the closed space open to the atmosphere.

According to this, the tool holder can improve in the symmetry to the rotating center and maintain the rotating stability in high-speed rotation. Besides, ~~according to an effect~~ affection of centrifugal force, is that dense mist cutting fluid or droplets are actively led into the passage hole 11a along an inside wall of the closed space to lubricate the tip of the tool.

According to a ~~In the~~ second feature of the invention, a holder rear end part is fixed on a front-end part of a spindle of a machine tool. And besides, a tool holder is so constructed that a tool receiving surface part receives ~~for receiving~~ a rear end face of a shaft-like tool fixed on a holder front end part so that a closed space in contact with the rear end face can be formed, and ~~as well as~~ mist cutting fluid passages for leading mist cutting fluid fed from a front end part of a spindle to the closed space are formed at ~~on~~ a ~~rotating~~ center of rotation of a holder body. Here, the tool receiving surface part is excavated rearward to form an excavated part comparatively large in diameter. ~~On the other~~ hand, the front end parts of the mist cutting fluid passages are protruded so as to form a circular space between its peripheral part and the excavated part. Besides, exhaust passages are formed for opening a circular portion of outer concentric portion of the mist cutting fluid passages near the ~~rotating~~ center of rotation of the rear end face of the excavated part to the atmosphere. In this case, it is preferable that a diameter of the excavated part 8g is about equal to the distance between the passage holes 11a in a radial direction.

According to this, in addition to the same effects as the first feature ~~invention~~, the following effects can be gained. Since the mist cutting fluid in the front-end part of the mist cutting fluid passages flows into the closed space near the rear end face of the shaft-like tool, it is not much affected by the excavated part, which is comparatively large in diameter. Therefore, the mist cutting fluid is prevented from liquefying in the closed space, instead effectively flowing to the atmosphere through the passage holes of the shaft-like tool. Besides, even if the liquefaction is temporarily excessive in the mist cutting fluid passages, the liquefied cutting fluid is temporarily accumulated in the excavated part. According to this, the liquefied cutting fluid can not interrupt the outflow ~~flow-out~~ of the mist cutting fluid through the passage holes of the shaft-like tool. In this case, the front end part of the mist cutting fluid passages can effectively restrict mixing and stirring the cutting fluid temporarily, much

accumulated along the inside periphery of the excavated part with the mist cutting fluid flowing therefrom. Moreover, when the diameter of the excavated part is about equal to the distance between the passage holes 11a, 11a, the dense mist cutting fluid or the droplets near the wall of the excavated part are immediately and actively led to the passage holes 11a, 11a by the effect of centrifugal force affection.

5           The above-mentioned features ~~inventions~~ can be embodied ~~put into concrete~~ as follows.

The tool receiving surface part forms a front-end face of a tool-receiving member adjustable in a longitudinal position in the holder body. According to this, even if the longitudinal position of the shaft-like tool is changed by longitudinally displacing the tool-receiving member, the effects ~~affections~~ of the above-mentioned inventions can be gained. Here, since the tool-receiving member in the  
10 present invention is the same as that used in a conventional tool holder, different members for forming it are not especially needed.

In addition ~~Besides~~, a tool receiving member portion of the rear of the excavated part forms a double pipe structure concentric with the a-rotating center of rotation thereof. The inside of an inner tube of the double pipe structure part forms a part of the mist cutting fluid passages, and a circular space  
15 between the inner tube and an outer tube thereof forms the first exhaust passage portion by due to opening into the excavated part. In this case, the circular space preferably reduces the diameter of the first exhaust passage 8k to the excavated part. According to this, the exhaust passage becomes superior in symmetry with respect to the rotating center of rotation of the tool holder, thereby securing the rotational stability thereof in high speed rotation, as well as preventing the dense mist cutting fluid or  
20 the droplets from flowing therein.

Furthermore, the rearward circular space is so formed as to open to the atmosphere through an inner space of a holder body portion surrounding the rear end part of the double pipe structure part, the second exhaust passage portion, and a space of a tool fixing part formed to the front end part of the

holder body. Here, the second exhaust passage is formed between the tool receiving member and the holder body. Accordingly, the outside periphery of the tool is efficiently lubricated.

Besides, an automatic switching valve is provided in the exhaust passage, which opens when air pressure in the closed space is more than a the fixed level. According to this, the automatic switching valve opens only when the mist cutting fluid is apt to stagnate in the mist cutting fluid passages, and the mist cutting fluid flows from the exhaust passages to the atmosphere, thereby decompressing the mist cutting fluid passages. Therefore, the mist cutting fluid therein improves in flow.

Moreover, a cylindrical valve for switching the exhaust passage and a spring for pressing the cylindrical valve forward are externally inserted and mounted on the periphery of the mist cutting fluid passages at the rearward tool receiving member portion of the double pipe structure part. When the air pressure of the closed space is more than the fixed level, the cylindrical valve is pressed and displaced rearward against an elastic force of the spring to open the exhaust passage. Conversely, when it is less than the fixed level, the cylindrical valve is pressed and displaced forward by the elastic force to close it. According to this, the cylindrical valve and the spring become superior in symmetry with respect to ~~concerning the rotating~~ center of rotation of the tool holder, thereby improving the rotational stability thereof as well as making the automatic switching valve in compact.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view from the side sight of a spindle device of a machine tool having a tool holder showing an embodiment of the present invention.

Fig. 2 is a sectional side view ~~from side sight~~ of the tool holder.

Fig. 3 is an enlarged sectional view around a tool receiving member of the tool holder.

Fig. 4 is a sectional view taken on line x-x in Fig. 1.

Fig. 5 is a sectional view taken on x1-x1 in Fig. 1.

Fig. 6 is a sectional view taken on x2-x2 in Fig. 1.

5 holder.

Fig. 8 is an explanatory view showing an operational condition acting situation of a the first variation of the deformed embodiment of Fig. 1.

Fig. 9 is an explanatory view showing another operational condition acting situation of the first variation deformed embodiment.

10 Fig. 10 is a sectional side view from side sight showing a the second variation deformed embodiment.

Fig. 11 is a sectional side view from side sight of a conventional tool holder.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

15 The present invention will be explained as follows with reference to the drawings.

Fig. 1 is a sectional side view from side sight of a spindle device of a machine tool having a tool holder showing an embodiment of the present invention, and Fig. 2 is a sectional side view from side sight of the tool holder. Fig. 3 is an enlarged sectional view around a tool receiving member of the tool holder. Fig. 4 is a sectional view taken on line x-x in Fig. 1, Fig. 5 is a sectional view taken on x1-x1 in Fig. 1, and Fig. 6 is a sectional view taken on X2-x2 in Fig. 1.

In these figures, 1 is a spindle of a machine tool, which has a taper hole 1a and coaxial parallel large and small holes 1b, 1c at on a rotating center of rotation R thereof. A cylindrical clamp part 2 comprising a large-diameter part 2a and a small-diameter part 2b and as well as a draw bar part 3 for

longitudinally displacing the cylindrical clamp part 2 are inserted in the centers of the holes 1a, 1b, 1c. In addition ~~And besides~~, a plurality of spindle-side collets 4 is circularly engaged between the cylindrical clamp part 2 and the spindle 1.

In this case, a straight mist cutting fluid passage 5 is formed ~~to~~ at the centers of the cylindrical clamp part 2 and the draw bar part 3, transferring mist cutting fluid generated outside or inside the spindle 1 to a front fl of the spindle 1.

The cylindrical clamp part 2 moves in a longitudinal direction f with ~~together~~ the draw bar 3. The draw bar is comparatively small in diameter. In this case, when the draw bar 3 is displaced in ~~to~~ the front direction fl, the large-diameter part 2a goes through ~~from~~ the spindle-side collets 4 group in ~~to~~ the front direction fl, and the rear end part of the small-diameter part 2b moves forward ~~gets out~~ of the rear end of each spindle-side collet 4 ~~forward to be~~ on the periphery thereof. Accordingly, the circular spindle-side collets 4 group is freely displaced in a radial direction. Conversely, when the draw bar 3 is displaced in ~~to~~ a rear direction f2, the large-diameter part 2a is moved ~~interfitted~~ from the outside of the spindle-side collets 4 group in ~~to~~ the rear direction f2 to interfit with the group of spindle-side collets, and the rear end part of the small-diameter part 2b is moved ~~interfitted~~ into the rear end of each spindle-side collet 4 to interfit therewith. Accordingly, the diameter of the spindle-side collets 4 group has the diameter is enlarged to in the maximum to be fixed in place.

Numerical 6 is a tool holder 6 of the present invention, fixed on the spindle 1 concentrically with the ~~rotating~~ center of rotation R thereof. The tool holder 6 is provided with a holder body 7, a tool receiving member 8, a protuberant connecting member 9 and a tool fixing part 10.

The holder body 7 is ~~symmetricized concerning with~~ the ~~rotating~~ center of rotation R, comprising a gripped part 7a, a cylindrical tapered shaft part 7b, a straight part 7c, an external thread part 7d, a circular concavity 7e, a radial surface part 7f, ~~a circular concave 7e~~, an internal thread 7g, a



tapered hole 7h, a thread hole 7i and a small-diameter hole 7j, as shown in Fig. 2. The gripped part 7a is large in diameter. The cylindrical tapered shaft part 7b is provided to the rear f2 of the gripped part 7a, and the straight part 7c is provided to the front f1 thereof. The external thread part 7d is formed to the front of the straight part 7c. The circular concavity 7e is formed on to the inside periphery of the tapered shaft part 7b, and the radial surface part 7f is formed on to the forefront end thereof. The internal thread 7g is formed at to the center of the radial surface part 7f. The tapered hole 7h is formed at to the front f1 of the inside of the straight part 7c, and the thread hole 7i is formed to the rear f2 thereof so as to be communicated with to the tapered hole 7h. Besides, the small-diameter hole 7j is formed at to the center of the gripped part 7a for communicating the internal thread 7g with and the thread hole 7i.

The tool receiving member 8, which is screwed into the thread hole 7i displaceably in the longitudinal direction f, comprises an external thread part 8a and a slender passage part 8c. The slender passage part 8c extends from the rear end face 8b of the external thread part 8a in to the rear direction f2 to be inserted into the small-diameter hole 7j. The front end face of the external thread part 8a forms a tapered tool receiving surface part 8d for receiving the outside periphery of the rear end face of a shaft-like tool 11 such as a drill so as to form a closed space 12 contacting to the rear end face. In addition Besides, a second exhaust passage 8e is provided between the external thread part 8a and the thread hole 7i by forming a longitudinal grooved passage on a peripheral thread surface of the external thread part 8a. Moreover, a straight forward mist cutting fluid passage 8f comparatively small in diameter is formed at to the ~~rotating~~ centers of rotation R of the external thread part 8a and the slender passage part 8c.

A circular hole-like excavated part 8g is formed at to the center of the tool receiving surface part 8d of the external thread part 8a, extending in to the rear direction f2, the excavated part having ~~which has~~ a larger diameter than the forward mist cutting fluid passage 8f. The front end part 8h of the

forward mist cutting fluid passage 8f protrudes from the rear end face of the excavated part 8g in to the front direction f1, and a forward opening thereof is located as close as possible to the rear end face of the shaft-like tool 11 as closely as possible.

The rear ~~f2~~ of the excavated part 8g of a part of the external thread part 8a forms a double pipe structure part as shown in Fig. 3. The inside of an inner pipe part 8i forms a part of the forward mist cutting fluid passage 8f. A circular space 8k between an outer pipe part 8j and the inner pipe part 8i forms the first exhaust passage portion, having a the front end opening in the excavated part 8g and a the rear end communicating with to radial holes 8m, 8m formed inside the thickness part of the front end face of the slender passage part 8c. In this case, the front end of the first exhaust passage portion 8k is located near the ~~rotating~~ center of rotation of the rear end face of the excavated part 8g, making a the circular portion concentric with the ~~rotating~~ center of rotation R and opening 'a'.

The protuberant communicating member 9, as shown in Fig. 2, comprises a comparatively short external thread part 9a and a straight protruding part 9b. The external thread part 9a is screwed to the internal thread part 7g in order to be integrally fixed on the holder body 7. The straight protruding part 9b is so constructed that a straight rearward mist cutting fluid passage 9c for extending the forward mist cutting fluid passage 8f in to the rear direction f2 is provided at to the ~~rotating~~ center of rotation R, and that the periphery of the rear end part is inserted into the forward-enlarged part 5a of the mist cutting fluid feeding passage 5. In this case, the slender passage part 8c is inserted into the front of the rearward mist cutting fluid passage 9c, and the forward mist cutting fluid passage 8f and the rearward mist cutting fluid passage 9c in the slender passage part 8c are airtightly communicated through a sealing member. Besides, the straight protruding part 9b and the forward-enlarged part 5a are airtightly communicated through a sealing member fixed thereon.

The tool fixing part 10 comprises three tool collets 13 and a fastening nut body 14. The tool

collets 13 are circularly interfitted into the tapered hole 7h. The fastening nut body 14 is externally screwed on in the external thread part 7d to displace the circular tool side collets 13 group in to the longitudinal direction f. In this case, when the fastening nut body 14 is turned in to a closing direction side around the ~~rotating~~ center of rotation R, it presses the tool side collets 13 group in to the rear direction f2 to reduce the diameter due to interaction with the tapered hole 7h. Conversely, when it is turned in the opposite direction ~~to the closing side~~, it pulls the tool side collets 13 group in to the front direction f1 to expand the diameter.

The base part of the shaft-like tool 11 is inserted into the central hole of the tool side collets 13 group. In this case, by ~~according to~~ turning the fastening nut body 14 in to the above-mentioned closing direction ~~one side~~, the base part of the shaft-like tool 11 is fastened to the tool side collets 13 group in order to be integrally fixed on the holder body 7 by as being drawn in to the rear direction f2. Besides, the periphery of the rear end face of the shaft-like tool 11 is airtightly pressed on the tool receiving surface part 8d. Conversely, according to rotating it in to the opposite direction side, the tool side collets 13 group is displaced so as to expand the diameter to enable the base of the shaft-like tool 11 to be pulled out of the central hole.

The shaft-like tool 11 is provided with passage holes 11a, 11a for passing cutting fluid in a longitudinal direction through to one or a plurality of portions (in figures, two portions) of the thickness ~~in a longitudinal direction~~. A cutting part of the shaft-like tool like can have ~~this is~~ various sizes in diameter, occasionally 1 mm to 5 mm. The diameter of the passage hole 11a of a ~~the~~ cutting part having a small ~~in~~ diameter like this is, for example, ~~made in~~ about 0.1 mm to 0.5 mm. These passage holes 11a, 11a have inlet openings and outlet openings on the rear end face and on the front end face of the shaft-like tool 11, respectively. In this case, two inlet openings are located in the closed space 12.

In the above-mentioned structure, the forward mist cutting fluid passage 8f and the rearward

cutting fluid passage 9c serve as ~~for~~ a mist cutting fluid passage of the tool holder 6. Besides, the first exhaust passage portion 8k, two radial holes 8m, 8m, an internal space 15 of the holder body 7 surrounding the peripheral rear part of the double pipe structure part of the external thread part 8a, the second exhaust passage portion 8e, an internal space 16 of the holder body 7 surrounding the front ~~fl~~ of ~~than~~ the external thread part 8a, and a space between the tool side collets 13, etc. serve as ~~for~~ an exhaust passage for opening a part of the tool receiving surface part 8d abutted on the closed space 12 to the atmosphere.

An explanation about the operation of each part, ~~and~~ using an example of the above-mentioned device, is as follows.

When fixing the tool holder 6 on the spindle 1, at first, the draw bar part 3 is displaced in ~~to~~ the rear direction f2 to displace the cylindrical clamp part 2 thereto, and therefore, the spindle side collets 4 group in circular arrangement is freely displaced to reduce diameter.

In ~~Under~~ this situation, the tapered shaft part 7b of the tool holder 6 is pushed into the tapered hole 1a of the spindle 1 with the gripped part 7a gripped. Hence, the tapered shaft part 7b is deeply inserted into the tapered hole 1a by reducing the diameter of the spindle side collets 4 group at ~~due to~~ the inside periphery thereof. The forefront large diameter part 4a of the spindle side collets 4 group is located in the circular concave part 7e of the inside periphery of the tapered shaft part 7b. Besides, the rear end part of the protuberant communicating member 9 is interfitted into the forefront enlarged part 5a to airtightly communicate the mist cutting fluid feeding passage 5 with ~~to~~ the rearward mist cutting fluid passage 9c.

Thereafter, the draw bar 3 is pulled in ~~to~~ the rear direction f2 to enlarge the diameter of the spindle side collets 4 group. Here, the forefront large-diameter part 4a is engaged with ~~to~~ the circular convex part 7e. Then, the tapered shaft part 7b is pulled to the rear direction f2 to be

exactly-concentrically fixed on the specified position of the spindle 1 as shown in Fig. 1.

Besides, when the fixed tool holder 6 is detached from the spindle 1, ~~the steps an order~~ for fixedly attaching it thereon ~~are~~ is performed in reverse order.

When machining a work, first of all, the spindle 1 is rotated, and ~~besides~~, the mist cutting fluid  
5 is fed into the mist cutting fluid feeding passage 5 of the spindle 1 from the rear thereof. In this case,  
the rotation of the spindle 1 is transmitted ~~communicated~~ to the tool holder 6 by friction force caused  
between the tapered hole 1a and the tapered shaft part 7b to rotate the tool holder 6 concentrically  
therewith. Here, the mist cutting fluid may be generated outside the spindle 1 or thereinside. The  
mist cutting fluid inside the mist cutting fluid feeding passage 5 reaches the forward mist cutting fluid  
10 passage 8f through the rearward cutting fluid passage 9c, and then, the inside of the closed space 12  
covering the rear end face of the shaft-like tool 11, continuously. Thereafter, it spouts from the outlet  
opening of the front end face of the shaft-like tool 11 through the passage holes 11a, 11a, and besides,  
flows to the atmosphere in front of the tool fixing part 10 through the exhaust passage comprising the  
first exhaust passage portion 8k, the internal space 15 of the thread hole part 7i on the rear of the external  
15 thread part 8a, the second exhaust passage part 8e, and each space among three tool side collets 13 of the  
tool fixing part 10.

Next, the spindle 1 is displaced toward the workpiece to cut it on the front end of the shaft-like  
tool 11. During this cutting process, the mist cutting fluid flowing out of the front end of the shaft-like  
tool 11 lubricates the cutting portion of the workpiece being cut.

20 During such ~~the work~~ machining like this, when the spindle 1 rotates more than 6000 times  
per minute and in case the passage hole 11a is small, as in a small-diameter tool, the mist cutting fluid in  
a passage group comprising the mist cutting fluid feeding passage 5, the rearward mist cutting fluid  
passage 9c, the forward mist cutting fluid passage 8f and the closed space 12 receives strong centrifugal

force due to the rotation of the tool holder 6, and liquefaction is to be promoted in liquefaction. In this case, when the mist cutting fluid does not flow out of the exhaust passages to the atmosphere, the flow velocity thereof in the passage group is excessively slow because of the a small flow quantity flowing out of the passage holes 11a, 11a. Therefore, the liquefaction of the mist cutting fluid is greatly  
5 promoted. The liquefied cutting fluid stagnates in the passage group so as to be gradually accumulated, and consequently, a comparatively long time is needed for reaching the tip of the tool.

However, in fact, since the mist cutting fluid reaching in the closed space 12 flows out of the exhaust passages to the atmosphere in by an adequate flow quantity, the flow velocity thereof in the passage group is increased, and consequently, a self-stirring function is increased. Therefore, the  
10 liquefaction of the mist cutting fluid can be restricted. Besides, even if the mist cutting fluid is partially liquefied, the liquefied cutting fluid can make the mist cutting fluid in large flow velocity flow into the closed space 12 rapidly in a large flow velocity. In this case, the high density and low density mist cutting fluids in high density and in low density smoothly flow into the passage hole 11a and into the exhaust passages, respectively. Therefore, even if machining time is prolonged passes away, an  
15 excessive of liquefied cutting fluid is not accumulated on the inner wall surfaces of the mist cutting fluid passages 9c, 8f in circularity, as happened previously usual. Accordingly, the flow quantity of mist cutting fluid flowing out through the passage holes 11a, 11a during the work machining is enough to lubricate the work cutting portion of the shaft-like tool 11. Fig. 7 shows a proper flow situation of the cutting fluid like this. As shown in this figure, the liquefied cutting fluid 'b' barely accumulates only  
20 near the inlet opening of the passage hole 11a in circularity besides the insides of the front end part 8h and the closed space 12. The accumulated cutting fluid 'b' never grows, even if the time is prolonged passes away.

In the above-mentioned flow of the mist cutting fluid, the forefront of the front end part 8h is

located near the rear end face of the shaft-like tool 11. Therefore, the mist cutting fluid flowing out the front end part 8h passes through the excavated part 8g with a radius of the same length as the distance from the center of the passage hole 11a, and ~~the one in~~ high density mist cutting fluid in among it flows into the passage holes 11a, 11a ~~by according to the~~ centrifugal force.

5           During the ~~work machining operation~~, when an excessive liquefaction temporarily occurs in the mist cutting fluid passages 5, 9c, 8f because either the tool holder 6 greatly increases in rotation velocity or the passage holes 11a, 11a are somewhat closed by cutting chips, etc., the liquefied cutting fluid is rapidly fed therefrom to the excavated part 8g by the mist cutting fluid at a in large flow velocity. Then, it is temporarily accumulated therein, and thereafter flows to the atmosphere through the passage  
10 11a. Accordingly, the mist cutting fluid in the mist cutting fluid passages 5, 9c, 8f can flow stably flow.

Besides, since there exists an opening 'a' in of the first exhaust passage portion 8k on the circular portion around the rotating center of rotation R of the rear end face of the excavated part 8g, a gas component separated from the mist cutting fluid by the centrifugal force flows therefrom. On the other hand, a liquid component remains on the inside periphery of the excavated part 8g in circularity,  
15 and it flows out of the passage hole 11a when the remaining quantity increases.

Since the front end part 8h is protruded from the rear end face of the excavated part 8g in to the front direction f1, an interference between the forward flow flowing out of the front end part 8h and the rearward flow going for the first exhaust passage portion 8k in the excavated part 8g is restricted. Therefore, the mist cutting fluid can flow effectively in the closed space 12.

20           A ~~The first variation deformed example~~ of the above-mentioned embodiment will be explained as follows. Fig. 8 is an explanatory view of working situation thereof, and Fig. 9 is an explanation view of another variation ~~deformed example~~.

An automatically switching valve 17 is provided in the exhaust passage. The switching

valve 17 comprises a cylindrical valve body 17a, a coil-like spring 17b and an engaging ring 17c. The cylindrical valve body 17a ~~is to~~ covers the outlet openings 'c' of the radial holes 8m, 8m, being externally inserted on to the outside periphery of the slender passage part 8c airtightly and slidably in the longitudinal direction through a not-illustrated packing. Here, the outside periphery of the slender passage part 8c serves as the peripheral wall part of the forward mist cutting fluid passage 8f. The coil-like spring 17b is to press the cylindrical valve body 17a in to the front direction f1, being externally inserted on to the outside periphery of the slender passage part 8c and compressed by through the engaging ring 17c ~~in compressed situation~~. In this case, the front end face of the cylindrical valve body 17a is formed so as to be airtightly engage ~~applied on~~ the rear end face 8b of the external thread part 8a.

The varied ~~Thus deformed~~ embodiment is operated as follows. When the mist cutting fluid in the closed space 12 flows to the atmosphere through the passage holes 11a, 11a in a quantity above a over fixed flow quantity, the air pressure in the forward mist cutting fluid passage 8f is comparatively lowered. The flow velocity of the mist cutting fluid flowing in the passage 8f is made at ~~in~~ a speed that does not excessively accumulate the liquefied cutting fluid in the mist cutting fluid passages 5, 9c, 8f. Therefore, the mist cutting fluid need not be flowed from the exhaust passages 8k, 8m, 8e. However, in this situation, as shown in Fig. 8, the front end face of the cylindrical valve body 17a is displaced in to the front direction f1 by the spring 17b, ~~to be airtightly engaging applied on~~ the rear end face 8b of the external thread part 8a. Consequently, the cylindrical valve body 17a blockades the radial holes 8m, 8m. According to this, the mist cutting fluid is prevented from flowing to the atmosphere needlessly in vain.

On the other hand, when the mist cutting fluid in the closed space 12 flows to the atmosphere through the passage holes 11a, 11a in a quantity below under the fixed flow quantity, the pressure in the forward mist cutting fluid passage 8f or the closed space 12 is comparatively high ~~heightened~~. The



flow velocity of the mist cutting fluid flowing in the passage 8f is decreased enough to excessively accumulate the liquefied cutting fluid in the mist cutting fluid passages 5, 9c, 8f. Therefore, the mist cutting fluid needs to be flowed out of the exhaust passages 8k, 8e. However, in this situation, as shown in Fig. 9, the cylindrical valve body 17a is displaced in to the rear direction f2 against the spring 17b by an air pressure acting on the inside face thereof to be separated from the rear end face 8b by a part only a distance corresponding to the air pressure ~~from the rear end face 8b~~. Therefore, the radial holes 8m, 8m are communicated to the atmosphere with proper passage cross-section. According to this, the mist cutting fluid adequately flows to the atmosphere, thereby preventing the liquefied cutting fluid from excessively accumulating in the mist cutting fluid passages 5, 9c, 8f.

Next, the second variation ~~deformed example~~ of the above-mentioned embodiment will be explained. Fig. 10 is a sectional side view ~~from side sight~~ showing the variation ~~deformed example~~. As shown in this figure, the excavated part 8g is not formed in to the tool receiving surface part 8d, and the double pipe structure part is formed near the rotating center of rotation of the external thread part 8a similarly to ~~with~~ the above example. That is, the inside of the inner tube part 8i forms the forward mist cutting fluid passage 8f, and the circular space between the inner tube part 8i and the outer tube part 8j forms the first exhaust passage 8k. Accordingly, there are two differences from the above example, namely, special effects ~~affections~~ due to the excavated part 8g and the front end part 8h of the forward mist cutting fluid passage 8f are not obtained. ~~Because the closed space 12 is narrow~~ due to the absence of the ~~owing to no~~ excavated part 8g and the front end part 8h does not protrude ~~to~~ in the front direction f1 in the closed space 12. However, there is an effect ~~affection~~ based on the outflow ~~flow-out~~ of a part of the mist cutting fluid in the closed space 12 from the exhaust passages 8k, 8e to the atmosphere similarly with ~~to~~ the above example.

In this case, instead ~~in~~ ~~stead~~ of the circular first exhaust passage 8k, a non-circular longitudinal

hole 8k, such as a drill hole, may be formed in to the thickness of the external thread part 8a outside the forward mist cutting fluid passage 8f.

To simplify the structure, it can be so constructed that the mist cutting fluid in the closed space 12 is discharged through the radial holes of the holder body 7 and the external thread part 8a. This  
5 construction is also within the range of the present invention.

## INDUSTRIAL APPLICABILITY

According to the present invention, the following effects will be gained.

That is, even if in case the cutting fluid accumulates because the shaft-like tool 11 is small in  
10 diameter and little mist cutting fluid flows to the atmosphere through the passage hole 11a and the flow in the passage is poor, the cutting fluid is rapidly transferred by as keeping the flow velocity of the mist cutting fluid in the mist cutting fluid passages 5, 9c, 8k at a in proper level without changing the shaft-like tool 11. A required quantity of mist cutting fluid can continuously and stably flow from the front end of the passage hole 11a.

15 Besides, the symmetry ~~realness~~ to the ~~rotating~~ center of rotation can be easily maintained, and the rotating stability is made superior even in the high-speed rotation. The high density mist cutting fluid flows to the tip of the tool through the passage hole 11a, and the low density mist cutting fluid goes around to flow to the atmosphere.

In addition to the above-mentioned effects, the following effects can be gained. Even if the  
20 liquefaction in the mist cutting fluid passages 5, 9c, 8k is temporarily too much, the liquefied cutting fluid is temporarily accumulated in the excavated part 8g, which is comparatively large in diameter, and the mist cutting fluid is stably flowed through the mist cutting fluid passages 5, 9c, 8f and the passage hole 11a. Besides, the rotational influence of the excavated part 8g to the mist cutting fluid flowed

from the front end part 8h of the mist cutting fluid passages 5, 9c, 8f is restricted, and the mist cutting fluid flowed into the closed space 12 can be prevented from liquefying therein. Therefore, the mist cutting fluid in the closed space 12 can effectively flow to the atmosphere through the passage hole 11a. Besides, the front end part 8h of the mist cutting fluid passages 5, 9c, 8f can restrict the mist cutting fluid flowing therefrom and much cutting fluid accumulated in the excavated part 12 in circularity along the inside periphery thereof from being mixed and stirred. Accordingly, the mist cutting fluid in the closed space 12 can effectively flow to the atmosphere through the passage hole 11a.

Moreover, even if the longitudinal position of the shaft-like tool 11 is changed, the above-mentioned effects can be gained, and besides, the cutting fluid can be actively led to the passage hole 11a.

Furthermore, since the exhaust passages 8k, 8e are superior in the symmetry with respect to the rotating center of rotation of the tool holder, the rotational stability of the tool holder at the time when it is rotated in high speed is satisfactorily secured, and besides, the cutting fluid can be actively led to the passage hole 11a.

Besides, the mist cutting fluid can be applied on the tool without waste.

Moreover, the mist cutting fluid in the closed space 12 can be flowed from the exhaust passages 8k, 8e to the atmosphere only when it is required, thereby preventing from the waste of the mist cutting fluid.

Furthermore, a structure for automatically flowing the mist cutting fluid in the closed space 12 to the atmosphere through the exhaust passages 8k, 8e only when it is required can be made compacted without damaging the rotational stability of the tool holder.

## ABSTRACT

A tool holder of a machine tool, wherein a holder rear end part is fixed to the front end part of the spindle of the machine tool, a tool receiving surface part 8d for receiving the rear end face of a shaft-like tool 11 fixed to a holder front end part so that a closed space in contact with the rear end face  
5 can be formed, and mist cutting fluid passages 8f, 9c for leading mist cutting fluid fed from the front end part of the spindle to the closed space 12 are formed in a holder body at on a rotating center of rotation, and exhaust passages are formed for opening a part of the tool receiving surface part in contact with the closed space 12 to the atmosphere, whereby even when the shaft-like tool 11 is small in diameter and the amount of the mist cutting fluid flowing out to the atmosphere through a passage hole 11a in the  
10 shaft-like tool is small, the liquefied cutting fluid can be prevented from being accumulated in the mist cutting fluid passages by maintaining the flow velocity of the mist cutting fluid in the mist cutting fluid passages 8f, 9c at a proper level.